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TRAFFIC STUDIES FOR PLANNING BYPASSES AROUND TOWNS

THE INDIAN ROADS CONGRESS
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TRAFFIC STUDIES FOR PLANNING BYPASSES AROUND TOWNS

1. INTRODUCTION

1.1. The Traffic Studies for Planning Bypasses Around Towns have been under the consideration of the Traffic Engineering Committee of the Indian Roads Congress for some time. The Traffic Engineering Committee in their meeting held at New Delhi on the 12th June, 1987 (personnel given below) had discussed the document and decided that Shri J. B. Mathur, D. S. (R), IRC and Shri D. Sanyal, Member-Secretary, Traffic Engineering Committee revise this document keeping in view the observations made during the meeting :

Dr. N. S. Srinivasan	...	*Convenor*
D. Sanyal	...	*Member-Secretary*
U. K. Agarwal		K. Suryanarayana Rao
K. Arunachalam		Prof. N. Ranganathan
R. T. Atre		Dr. O. S. Sahgal
A. K. Bandopadhyaya		D. V. Sahni
P. S. Bawa		Dr. A. C. Sarna
A. K. Bhattacharya		R. K. Saxena
Dilip Bhattacharya		H. C. Sethi
S. P. Bhargava		H. M. Shah
A. G. Borkar		R. P. Sikka
P. Das		R. Thillainayagam
S. B. Deol		V. V. Thakar
T. Ghosh		D. L. Vaidya
Dr. A. K. Gupta		Prof. Dinesh Mohan
Joginder Singh		P. G. Valsankar
Dr. C. E. G. Justo		C. E. (NH), Kerala (V. S. Iyer)
Dr. L. R. Kadiyali		Director, Transport Research,
V. P. Kamdar		MOST (R. C. Sharma)
Dr. S. K. Khanna		The Chief, Transport & Communication Board, B.M.R.D.A. (R. Y. Tambe)
N. V. Merani		
Narain Prakash Mathur		
K. C. Nayak		S. E. Traffic Engg. & Management Cell, Madras
A. N. Nanda		
S. M. Parulkar		The President, IRC & DG (RD) (K. K. Sarin) -Ex-officio
Sheo Nandan Prasad		
Dr. S. P. Planiswamy		
Dr. S. P. Raghava Chari		The Secretary, IRC (Ninan Koshi) -Ex-officio
V. S. Rane		
Prof. M. S. V. Rao		

1.2. The revised document was discussed by the

Specifications and Standards Committee in their meeting held at New Delhi on 9th November, 1987. The Committee considered the draft in the light of the comments of members and decided that further revision to it might be carried out jointly by S/Shri D. Sanyal, J. B. Mathur and K. Arunachalam. The Committee also authorised the Group to finalise the draft.

1.3. The draft as revised by the Group was approved by the Executive Committee in their meeting held on the 26th April, 1988. Later on the document was placed before the Council in their 123rd meeting held at Guwahati on the 7th May, 1988. The Council approved the document for publication.

1.4. Traffic plying on rural highways many a time has to pass through the urban areas of various sizes with or without the purpose of halting within the urban areas. The non-halting traffic is known as through traffic with its origin and destination lying outside the limits of the urban area. The proportion of through traffic to total traffic in the case of medium sized towns (with population 1,00,000 to 5,00,000) and small sized towns (with population 20,000 to 1,00,000) will be larger than that of big cities. The frequent interaction of through traffic with the local traffic of the urban area besides bringing down the level of operation of both types of traffic would also erode the traffic environment of the township. In all such cases, proper planning of bypasses assumes great importance for providing unhindered movement to the through traffic and decongest the townships.

1.5. In many instances a bypass, after being constructed, soon becomes engulfed with the local activities resulting in a total loss of its desired functional character. Chances of such eventualities taking place must be obviated through planning the bypass alignment in relation to the master plan of the town in such a manner that the bypass remains unaffected by the local urban activities till the end of the design year. Tendencies of ribbon development along the bypass must also be totally curbed through proper legislation on land control and effective implementation. Various types of facilities along the bypass must be planned in the beginning itself and such facilities must be developed in an integrated manner.

2. SCOPE

2.1. Particulars such as volume, origin, destination, and delays, pertaining to through and local traffic are required for justifying the provision of a bypass. Depending upon its origin

and destination, the traffic going through a town can be classified as :

(i) External to external : Traffic whose orgin and destination both lie outside the town.

(ii) External to internal : Origin of traffic outside and destination inside the town.

(iii) Internal to external : Origin of traffic inside and destination outside the town; and

(iv) Internal : Traffic whose origin and destination both lie within the town.

2.2. External to external traffic is usually totally bypassable whereas other traffic is not. A portion of bypassable traffic may have to enter the town for purposes of refreshments, fuel filling, minor repairs, etc. By providing such facilities along the proposed bypass, the demands of this traffic can be easily met and the traffic successfully diverted. Such details must form an integral part of any proposed bypass.

2.3. In addition to above information, frequency and route description of the bypassable traffic is also required for planning the bypass. This information is collected through comprehensive surveys at suitably selected outer cordon points around the town.

2.4. This document provides guidelines on conducting studies on traffic required for planning bypasses as also analysis of the data. Suitable proformae for recording the data and their analysis are provided. An worked out example to illustrate the methodology is included.

3. ORIGIN AND DESTINATION SURVEY

3.1. Selection of Survey Points

Judicious location of survey points is necessary to get right data for the study. Survey stations should be located where the approach roads intersect the cordon line drawn to enclose the town under study. Fig. 1 indicates cordon line for a sample case. The following points should be kept in view while locating the cordon :

(i) the cordon line should be well away from the town for effectively identifying the bypassable traffic; and

(ii) the cordon line should encompass all existing bypasses catering to regional traffic moving around the town.

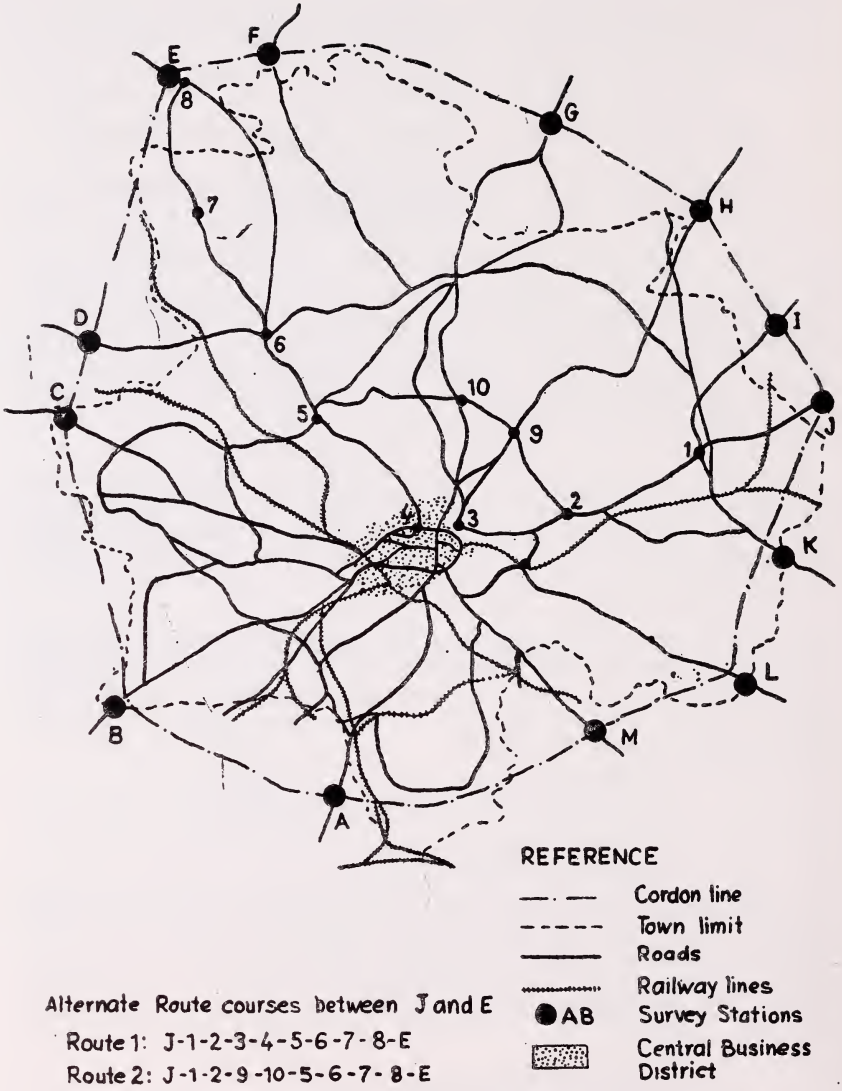

Fig. 1. Location of cordon line and survey stations for a sample case

3.2. Frequency and Duration of O-D Surveys

The surveys should be carried out simultaneously at all the selected locations, during the peak and the normal periods. The period in which these are conducted should be so selected as to trap representative characteristics of the traffic. The surveys should normally be conducted for seven consecutive days but in any case for not less than three days and must encompass the weekly market day and one working day.

3.3. Sample Size

3.3.1. As far as possible the survey should cover maximum percentage of traffic, and it is preferable to cover the entire traffic giving one hundred per cent sample size. When this is not possible the survey should cover a minimum percentage of traffic as given below :

During peak periods	:	25 per cent of volume of traffic.
During normal periods	:	50 per cent of volume of traffic.

3.3.2. In addition to this sample survey, traffic count should be conducted simultaneously during the survey period. This is mainly required to expand the sample to the total population. Traffic count data by vehicle type should also be collected for every 15 minute interval by using Form 1. Deployment of manpower for this purpose should be adequate.

3.4. Methodology

3.4.1. Depending upon the size of the town, accuracy required etc., the survey can be carried out by any of the following methods :

(i) Registration plate method ;

(ii) Tag and disc method ; or

(iii) Roadside interview method.

3.4.2. **Registration plate method** : Registration number of vehicles and time of entry and exit of the inbound and outbound vehicles are noted down by observers posted separately at each survey point. When survey is conducted on sampling basis for recording vehicles at entry and exit points, vehicles with registration numbers ending with pre-determined digits (say 0,5,7 and excluding the letters) only are recorded. This method does not cause any inconvenience to traffic and is suitable for very small towns. It is not possible to collect data regarding the purpose of trip, details of stopping through traffic, etc., by this method.

3.4.3. **Tag and disc method** : The vehicles entering the town are stopped at survey points and tags with entries such as the time of entry, place of entry and type of vehicle are tied to the front of the vehicles by the observers posted to cover the inbound traffic. Sometimes instead of tags, discs are distributed to the drivers. When the vehicles leave the town at the cordons, these tags of discs are collected by the surveyors posted at the survey points. Different coloured tags and discs can be distributed to identify the distributing station and type of vehicle with registration numbers ending with pre-determined digits (letters may be excluded) for easy identification.

3.4.4. **Roadside interview method**

3.4.4.1. Inbound vehicles are stopped at the survey points and information on time of interview, type of vehicle, registration number of vehicle etc., are noted down by the observer. Then the observer puts questions in a polite manner to the driver or occupant to get information on origin, destination, purpose of trip, number and purpose of halts within the town, route followed inside the town, etc. Form 2 may be used for collecting this information.

3.4.4.2. Random sampling may be adopted to avoid any bias. It is enough to conduct the survey on vehicles from one direction only, preferably inbound vehicles, due to the following reasons :

(i) the through traffic will be covered at the survey station at the approach to the town ;

(ii) this will avoid possibility of interviewing the through traffic twice, once at entry point and the second time at the exite point ; and

(iii) the local traffic will be partly eliminated.

3.4.5. **Requirements of survey stations :** Adequate care should be taken to locate the survey station well away from the carriageway to cause little interference to the passing traffic. If necessary, police help may be taken for conducting the survey. Adequate provision at survey point may be made to provide information to the road users regarding the purpose of the survey through installation of banners, etc.

4. TRAVEL TIME AND DELAY STUDIES

4.1. This study can be conducted by the moving car technique. By this technique, a test vehicle is run at the perceptible average speed of the traffic stream. The observers inside the test

vehicle note down the journey and delay timings and causes of delays. Depending upon the method of regulating the speed of the test car, the survey can be conducted by any one of the following methods :

(i) Floating car method

(ii) Average car method

(iii) Restricted car method

4.2. In the floating car method, the driver tries to overtake an equal number of vehicles which overtake the test car. However, it is rather difficult to apply this method in our towns because of mixed traffic conditions.

4.3. In the average car method, the driver runs the test vehicle at the speed which he considers as the average speed of the traffic stream. This method is restricted to conditions of continuous flow of traffic only and cannot be applied for free flow conditions.

4.4. The restricted car method is the same as average car method. But it overcomes the disadvantage existing in the latter by restricting the speed of test vehicle under free flow conditions to predetermined speed limits.

4.5. The following preliminary work must be carried out prior to conducting the survey :

(i) the entire route must be divided into sections, each section having fairly homogeneous road and traffic characteristics along the entire length.

(ii) the restricted speed of test vehicle under free flow conditions is determined by considering the existing speed limits ; and

(iii) if existing speed limits are not satisfactory, spot speed study should be conducted and restricted speed limits determined.

4.6. The test vehicle is run in both directions of test sections in order to cover all conditions of traffic. The cause, duration and location of stops and other delays are recorded. For recording the readings, a tape recorder can be advantageously used. Form 3 may be used for carrying out this survey. In order to ensure accuracy of data, atleast six, and preferably a multiple of six runs per direction, must be made.

5. ANALYSIS

This part deals with processing and presenting the data collected from the surveys dealt with earlier, to evaluate the

necessity for bypass, and to select a suitable location therefore, if justified.

5.1. Analysis of Traffic Count

Hourly volumes of traffic passing through various survey points are obtained by tabulating the traffic volume counts in Form 4.

5.2. Analysis of Delays

From the survey the average delays (which covers all delays including waiting time at level crossing) involved for each route are compiled by summing up the delays involved in each run and then working out the average delay, Form 5.

5.3. Speed-flow Characteristics

From the data already collected, speed-flow characteristics of the existing facility must be ascertained. This would help in defining the level of service as obtaining at persent.

5.4. Analysis of Origin and Destination Data

The data obtained from origin and destination survey should be tabulated in Form 6 and the proportion of through traffic to total traffic obtained. The average delays during the 24 hour period as noted in Form 5 should be grouped for different sections of the entire route in Form 7.

5.5. Analysis of Speed and Delay Characteristics

5.5.1. The travel speeds and traffic volumes as obtained from Forms 3 and 4 respectively are used to develop a relationship between speed and volume for the route under study which may be of the following kind :

$$V_{est} = V_f - kQ$$

where V_{est} = estimated speed, km/h

V_f = average free speed, km/h

k = a coefficient

Q = average hourly traffic volume, vehicles per hour

5.5.2. The travel speeds of local traffic in the absence of through traffic and of through traffic in the absence of local traffic should be estimated from speed-volume relationship. The average travel time on different route sections should be found

out based on observed and estimated speeds. The average delays should be taken as the difference between the average travel time with the observed or estimated travel speed and the travel time with the average observed free speed. These values should be tabulated using Form 8 for the following cases :

(i) local traffic with through traffic;
(ii) local traffic without through traffic;
(iii) through traffic with local traffic; and
(iv) through traffic without local traffic.

5.5.3. The vehicle-wise break up of through traffic should be tabulated in Form 9.

5.5.4. The total loss in manhours and the total extra fuel consumed per day should be tabulated in the Form 10, for local traffic and through traffic separately for both the cases of their travelling together and separated from each other. The extra manhours and the extra fuel lost per day should be calculated as follows :

(i) extra manhours or extra fuel lost per day for local traffic	= manhours or fuel lost per day while travelling alongwith through traffic (observed) ***minus*** manhours or fuel lost per day while travelling without through traffic (estimated).
(ii) extra manhours or extra fuel lost per day for through traffic	= manhours or fuel lost per day while travelling alongwith local traffic (observed) ***minus*** manhours or fuel lost per day while travelling without local traffic (estimated).

5.5.5. The direct economic losses in the base year which include the extra manhours and extra fuel should be quantified by adopting suitable monentary values for local and through traffic in Form 11.

5.6. Projection

5.6.1. The necessity of a bypass can be better emphasized by working out the details for a future date since present demand may vastly increase due to :

(i) growth of the region; and
(ii) attraction of more traffic by new facility due to improved level of service offered.

5.6.2. A twenty year period is normally assumed to be the design period for a road project. However. this can be suitably altered to suit the local conditions.

5.6.3. The traffic counts pertaining to the town during previous years, if available, can be used for projecting the growth of traffic to the design year. If no such data is available, the traffic can be projected by the growth factor method, on considerations of the growth of region with respect to population, fuel consumption, number of registered motor vehicles etc. Changes in level of service for each year will then have to be determined keeping in view the projected yearly growth in traffic.

5.6.4. From the projected traffic, the vehicle-hours lost, manhours lost etc., and the anticipated economic loss for the design year could be obtained using Form 12.

5.6.5. The design speed, which depends on the characteristics of traffic in the region, can be obtained after comparing the speeds of traffic on similar bypasses in the region. With this data, the geometric details of the bypass and the cost of the projects to meet the needs of the projected traffic can be worked out.

5.7. Economic Analysis.

The economic savings due to the provision of the facility is compared with the anticipated economic loss had the existing facility been continued upto the design year for the purpose of justifying the construction of the bypass. While carrying out this economic analysis, savings due to likely reduction in number and severity of accidents brought about by the provision of a bypass and improvement in level of service offered by the existing facility due to a reduction in traffic volume levels (through traffic having been assigned to the bypass) should also be considered.

6. PRESENTATION

The through traffic analysed according to origin and destination in terms of passenger car units (Rural) and projected to design year is represented by means of desire line diagram, treating the survey points as origins and destinations. Such a diagram will clearly indicate the control points and the most suitable alignment for the bypass.

FORM 1 : Origin and Destination Survey — Traffic Counts

Date :

Name of the Town :

Sheet No. :

Survey Station :

Name of the Enumerator :

Weather condition :

Location (km) :

Direction of Travel :

Hours :

From : To :

Time Interval	Trucks, truck-trailers	Buses	Cars, Jeeps Vans, three-wheelers	Motor cycles and scooters	Cycles and cycle rickshaws	Animal drawn vehicles	Other slow moving vehicles (please specify)

FORM 2 : Origin and Destination Survey — Roadside Interview Method

Date :

Name of Town :

Sheet No. :

Survey Station :

Name of Interviewer :

Weather conditions :

Location (km) :

Direction of Travel :

Hours :

From : To :

Sl. No.	Time of interview	Vehicle type	Registration number	Trip origin	Trip destination	No. of persons in the vehicle	Goods carried		Whether likely to halt in the town		Trip purpose	Route course (via)	Whether a bypass will be desirable if not state reasons
							Type	Tonnage	No. of halts	Purpose of halts			

FORM 3 : Origin and Destination Survey—Travel Time and Delay Studies

Trial Run No. :

Name of Town :

Sheet No. :

From Survey Station :

To Survey Station :

Date :

Test Vehicle No. :

Name of Observer :

Run Starting Time :

Run Ending Time :

Location	Cumulative distance	Cumulative running time	Delays	
			Cause	Duration

FORM 4 : Origin and Destination Survey-Hourly Summary Sheet of Traffic Count

Date : Name of Town :

Survey Station : Direction of Travel :

Period	Fast moving vehicles				Total	Slow moving vehicles				Grand total (6+10)
	Trucks, truck-trailers	Buses	Cars, Jeeps, Vans, Three-wheelers	Motor cycles and scooters		Cycles and cycle rickshaws	Animal drawn vehicles	Other slow moving vehicles (please specify)	Total	
1	2	3	4	5	6	7	8	9	10	11
6 — 7 hours										
7 — 8 hours										
8 — 9 hours										
9 — 10 hours										
10 — 11 hours										
11 — 12 hours										
12 — 13 hours										
13 — 14 hours										
14 — 15 hours										
15 — 16 hours										
16 — 17 hours										
17 — 18 hours										
18 — 19 hours										
19 — 20 hours										
20 — 21 hours										
21 — 22 hours										
22 — 23 hours										
23 — 24 hours										
24 — 1 hours										
1 — 2 hours										
2 — 3 hours										
3 — 4 hours										
4 — 5 hours										
5 — 6 hours										

Note : This hourly summary is to be prepared from the count date Form 1.

FORM 5. Origin and Destination Survey Analysis of Delays

Name of Town : Date : Route No. : Route Course :

Period of Journey (Hours)	Duration of Delays (in minutes) in the Route							
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Total	Average
6 00 — 7.00								
7.00 — 8.00								
8.00 — 9.00								
9.00 – 10.00								
10.00 — 11.00								
11.00 — 12 00								
12 00 — 13 00								
13.00 — 14.00								
14.00 — 15.00								
15.00 — 16.00								
16.00 — 17.00								
17.00 — 18 00								
18.00 — 19.00								
19.00 — 20.00								
20 00 — 21.00								
21.00 — 22.00								
22.00 — 23 00								
23.00 — 24.00								
24.00 — 1 00								
1.00 — 2.00								
2 00 — 3 00								
3.00 — 4.00								
4.00 — 5.00								
5.00 — 6.00								

FORM 6. Origin and Destination Survey-Percentage of Bypassable Traffic

Date : Name of Town : Direction of Travel :

Survey Station	Total number of vehicles				Total	Percentage of bypassable traffic to total traffic	
	Fast moving vehicles	All vehicles	Through fast moving vehicles	Destination fast moving vehicles		Excluding slow moving vehicles $\frac{\text{Col.(4)}}{\text{Col.(2)}} \times 100$	All vehicles $\frac{\text{Col. (4)}}{\text{Col. (3)}} \times 100$
1	2	3	4	5	6	7	8

Note : The sample size as interviewed adopting Form 2 has to be expanded to the population considering the minimum and maximum intervals with respect of traffic count made in Form 1 and the expanded figures adopted in columns (4) and (5) of this Form 6.

FORM 7 : Origin and Destination Survey-Summary of Analysis of Delays on the Entire Route

Name of Town : Date :

Sl No.	Route Section	Length (km)	Period of journey (hours)	Average delay (minutes)
1.	1		8.00 — 12.00	
			12.00 — 16.00	
			16.00 — 20.00	
			20.00 — 8.00	
	2		8.00 — 12.00	
			12.00 — 16.00	
			16.00 — 20.00	
			20.00 — 8.00	

FORM 8 : Analysis of Observed and Estimated* Travel Speeds and Delays

Name of Town : Date :

Route Section	Length (kms)	Average hourly traffic volume (veh/hr)	Average travel time (mins)	Average travel speed (kmph)	Average free speed (kmph)	Average travel time with free speed (mins)	Average delay (mins)

*From Speed-volume relationship

$$Vest = V_f - KQ$$

where v = estimated speed, km/h
V_f = average free speed, km/h
K = a coefficient
Q = average hourly traffic volume in vehicles per hour

FORM 9. Origin and Destination Survey-Route Wise Analysis of Through Traffic

Date : Route No. : Route Course :

Name of Town :

Period (between hours)	Number of vehicles				Total
	Trucks, truck-trailers	Buses	Cars, Jeeps, Vans, Three-wheelers	Motor cycles and scooters	
8.00 — 12.00					
12.00 — 16.00					
16.00 — 20.00					
20.00 — 8.00					

Note : The sample size as interviewed adopting Form 2 has to be expanded to the population with respect to traffic counts made in Form 1 and the expanded figures adopted in Form 9.

FORM 10 Origin and Destination Survey Analysis of Economic Losses to Local and Through Traffic

Name of Town : Losses in Manhours and Fuel Route No. :

Vehicle type	Vehicles per day	Loss in manhours per day			Extra fuel consumed				Extra fuel consumed in idling		Present rate of consumption	Extra wear and tear in terms of fuel consumed in litres per day 12 (8+11)	Total extra fuel consumed in litres per day (3+11+13)
		Average delay per vehicle (mins.)	Average occupancy per vehicle	Manhours lost per day (in hour) $2\times3\times4/60$	Extra fuel consumed on acceleration and deceleration processes: Mean number of proscess	Extra fuel consumed per process in litres $\times 10^{-7}$	Extra fuel consumed per day in litres $\times 10^{-4}$ $2\times6\times7$	Mean stopped time in minutes	Extra fuel consumed per minute of idling $\times 10^{-7}$	Extra fuel consumed per day in litres $\times 10^{-4}$ $2\times9\times10$			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Car/Jeep			4.0			2268			31706		0.4579		
Scooter/ M. Cycle			1.5			2268			31706		0.4579		
Bus			50.0			6150			32976		0.4579		
Truck			2.0			4173			32976		0.4579		

FORM 11 : Assessment of Direct Economic Losses for Local and Through Traffic (Base Year)

Vehicle type	Man hours lost per day	Man hours lost per year	Total cost of man hours lost per year in rupees	Total extra fuel consumed in litres	Cost of fuel per litre in rupees	Total cost of extra fuel consumed per year in Rs	Total economic losses per year in rupees
1	2	3	4	5	6	7	8

FORM 12 : Projected Economic Losses for Through and Local Traffic

Year	Through traffic in vehicles per day	Direct economic losses for through traffic in lakh rupees	Local traffic in vehicles per day	Direct economic losses for local traffic in lakh rupees	Total direct economic losses for local and through traffic in lakh rupees
Base year					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

7. EXAMPLE-CASE STUDY

7.1. This part deals with an hypothetical case study in which the justification for planning a bypass for an urban area is explained.

7.2. Fig. 2 shows the urban area through which a major inter-urban arterial such as National Highway passes. Traffic studies for evaluating the drop in the level of service of traffic plying on the arterial and for planning a suitable bypass to decongest the urban township were conducted at carefully selected survey stations.

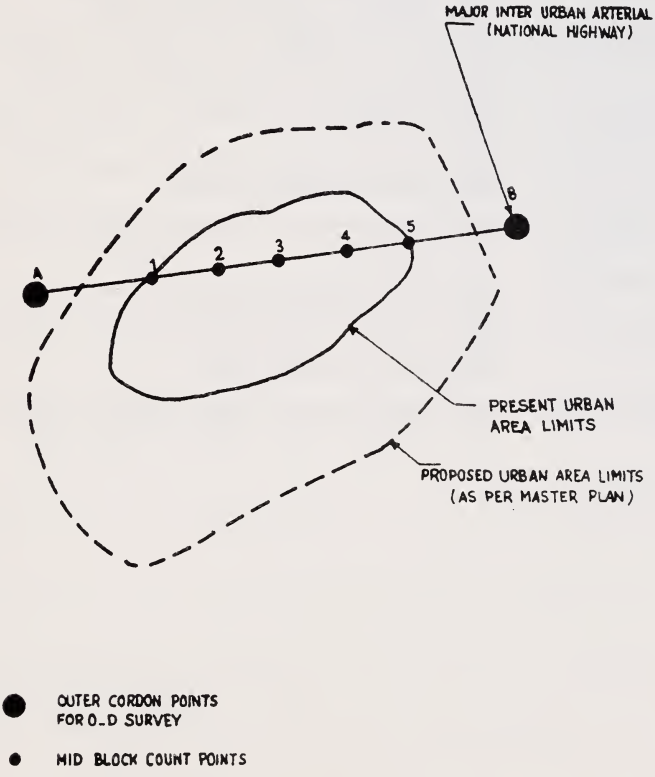

Fig. 2. Plan showing study area for the example case
(not to scale)

7.3. The 8 km long route of the arterial is divided into six sections. Based on the 0-D survey and information collected on

Form 1 and 2, origin and destination matrix for the vehicular traffic on the major urban arterial has been prepared and shown in Table E-1. Computation on sectionwise vehicular traffic is done in Table E-2. Mode-wise traffic on these route sections are given in Table E-3. The detailed methodology for carrying out the traffic volume counts, origin and destination survey and travel time and delay studies have already been explained in the earlier sections. The necessary data and analysis are given in the Tables listed below.

Table E- 4 : shows the hourly summary sheet of traffic count on route section A-1.

Table E- 5 : shows the duration of delays (in minutes) in the route section A-1 during 24 hour period.

Table E- 6 : shows the percentage of through or bypassable traffic to the total traffic plying on the arterial.

Table E- 7 : shows the summary of analysis of delays on the entire arterial.

Table E- 8 : shows the travel time and delay characteristics of local traffic and through traffic.

Table E- 9 : shows the mode-wise through traffic during the 24 hour period.

Table E-10 : shows the analysis of losses in man hours and fuel to local and through traffic.

Table E-11 : shows the direct economic losses in the base year for local and through traffic.

Table E-12 : shows the projected economic losses for through and local traffic for a design period of 20 years.

TABLE E-1. ORIGIN-DESTINATION MARTIX FOR THE VEHICULAR TRAFFIC ON THE MAJOR INTRA URBAN ARTERIAL (VEHICLES/DAY)

O \ D	*A*	*1*	*2*	*3*	*4*	*5*	*B*	*Total*
A		1800	2880	720	1080	720	4800	12000 Σ_D^A
1	384		1296					1680 Σ_D^1
2	576	888		6840				8304 Σ_D^2
3			4560		6192			10752 Σ_D^3
4				4152		336	720	5208 Σ_D^4
5					384		480	864 Σ_D^5
B	3840	576	864	576	2304	1440		9600 Σ_D^B
Total	4800 Σ_0^A	3264 Σ_0^1	9600 Σ_0^2	12288 Σ_0^3	9960 Σ_0^4	2496 Σ_0^5	6000 Σ_0^B	48408

Note : Σ_0^A—Summation of traffic over all origins with destination at A.

Σ_D^A—Summation of traffic over all destinations with origin at A.

Same description holds good for other notations also through or non-stopping or bypassable traffic

A—→B (4800) + B—→A (3840) = 8640 vehicles per day or 360 vehicles per hour.

See Fig. 2 for locations of sections.

TABLE E-2. COMPUTATION OF SECTIONWISE TRAFFIC ON THE MAJOR INTRA URBAN ARTERIAL

Sl. No.	*Section*	*Sections to be combined along with their average daily traffic in vehicle/day*	*Total average daily traffic in vehicle/day*
1	A—1	$\Sigma_0^A(4800) + \Sigma_D^A(12000)$	16800
2	1—2	$\Sigma_D^A(12000) - A1\ (1800) + BA\ (3840) + B1\ (576) + 2A\ (576) + 21\ (888) + 12\ (1296)$	17376
3	2—3	$\Sigma_D^A(12000) - A1\ (1800) - A2\ (2880) + BA\ (3840) + B1\ (576) + B2\ (864) + 23\ (6840) + 32\ (4560)$	24000
4	3—4	$\Sigma_D^A(12000) - A1\ (1800) - A2\ (2880) - A3\ (720) + \Sigma_D^B(9600) - B4\ (2304) - B5\ (1440) + 34\ (6192) + 43\ (4152)$	22800
5	4—5	$A5\ (720) + AB\ (4800) + \Sigma_D^B(9600) - B5\ (1440) + 45\ (336) + 54\ (384)$	14400
6	5—B	$\Sigma_0^B(6000) + \Sigma_D^B(9600)$	15600

Note : Sections and their corresponding traffic shown in the Table above have been taken from the origin-destination matrix (Table E-1).

A→1— Traffic with origin at A and destination at 1.

2→1— Traffic with origin at 2 and destination at 1.

Same description holds good for other notations also.

TABLE E-3. SECTION-WISE TRAFFIC ON THE MAJOR INTRA URBAN ARTERIAL

Sl. No.	Section	Length (km)	Average hourly traffic veh/hr	Average daily traffic veh/day	Fast moving vehicles per day					Slow moving vehicle per day			Grand Total
					Trucks, truck-trailers	Buses	Cars/ jeeps, vans three-wheelers	Motor cycles, scooters	Total	Cycles & cycle-rick-shaws	Animal drawn vehicles	Total	
1.	A-1	2.0	700	16800	8881	102	2000	3300	14283	1508	1009	2517	16800
2.	1-2	1.0	724	17376	7612	104	3000	4000	14716	1546	1114	2660	13376
3.	2-3	1.2	1000	24000	5050	144	7000	8134	20328	2136	1536	3672	24000
4.	3-4	1.3	950	22800	5025	136	6500	7649	19310	2029	1461	3490	22800
5.	4-5	1.5	600	14400	5100	86	3239	3771	12196	1281	923	2204	14400
6.	5-B	1.0	650	15600	7618	93	2000	3500	13211	1388	1001	2389	15600
Total		8.0											

TABLE E-4. ORIGIN AND DESTINATION SURVEY-HOURLY SUMMARY SHEET OF TRAFFIC COUNT (ROUTE SECTION A-1)

Date :

Survey Station :

Period	Fast moving vehicles					Slow moving vehicles			Grand Total
	Truck/ truck-trailers	Buses	Cars/Jeeps, Vans, three-wheelers	Motor-cycles/ scooters	Total	Cycles/ cycle-rickshaws	Animal drawn vehicles	Total	
6— 7 Hours	423	5	95	157	680	72	48	120	800
7— 8 ,,	740	8	167	275	1190	126	84	210	1400
8— 9 ,,	793	8	179	295	1275	135	90	225	1500
9—10 ,,	846	10	190	314	1360	144	96	240	1600
10—11 ,,	687	8	155	255	1105	117	78	195	1300
11—12 ,,	476	5	107	177	765	81	54	135	900
12—13 ,,	211	2	48	79	340	36	24	60	400
13—14 ,,	185	2	42	69	298	31	21	52	350
14—15 ,,	238	3	54	88	383	40	27	67	450
15—16 ,,	370	5	83	137	595	63	42	105	700
16—17 ,,	529	6	119	196	850	90	60	150	1000
17—18 ,,	687	8	155	255	1105	117	78	195	1300

18—19	,,	793	8	179	295	1275	135	90	225	1500
19—20	,,	529	6	119	196	850	90	60	150	1000
20—21	,,	370	4	84	137	595	63	42	105	700
21—22	,,	106	1	24	39	170	18	12	30	200
22—23	,,	132	2	30	49	213	22	15	37	250
23—24	,,	106	1	24	39	170	18	12	30	200
24— 1	,,	80	0	18	30	128	13	9	22	150
1— 2	,,	63	1	14	24	102	10	8	18	120
2— 3	,,	69	0	16	26	111	11	8	19	130
3— 4	,,	106	1	24	39	170	18	12	30	200
4— 5	,,	132	2	30	49	213	22	15	37	250
5— 6	,,	210	6	44	80	340	36	24	60	400
Total		8881	102	2000	3300	14283	1508	1009		16800

TABLE E-5. ORIGIN AND DESTINATION SURVEY—DURATION OF DELAYS (IN MINUTES, IN THE ROUTE SECTION A-1 (2.0 km)

Name of Town : Date : Route No. Route Course :

Period of Journey (hours)	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Total	Average
1	2	3	4	5	6	7	8	9
6— 7	1.12	1.11	1.13	1.14	1.12	1.16	6.78	1.13
7— 8	2.50	2.40	2.60	2.65	2.70	2.75	15.60	2.60
8— 9	2.72	2.62	2.82	2.87	2.92	2.97	16.92	2.82
9—10	2.95	2.85	3.05	3.10	3.15	3.20	18.30	3.05
10—11	2.30	2.20	2.40	2.45	2.50	2.55	14.40	2.40
11—12	1.14	1.04	1.24	1.29	1.34	1.39	7.44	1.24
12—13	0.43	0.33	0.53	0.58	0.63	0.68	3.18	0.53
13—14	0.48	0.47	0.49	0.54	0.59	0.64	2.94	0.49
14—15	0.46	0.36	0.56	0.61	0.66	0.71	3.36	0.56
15—16	0 93	0.83	1.03	1.08	1.13	1.18	6.18	1.03
16—17	1.03	0.93	1.13	1.18	1.23	1.28	6.78	1.13
17—18	2.30	2.20	2.40	2.45	2.50	2.55	14.40	2.40
18— 19	2.72	2.62	2.82	2.87	2.92	2.97	16.92	2.82
19—20	1.03	0.93	1.13	1.18	1.23	1.28	6.78	1.13
20—21	0.93	0.83	1.03	1.08	1.13	1.18	6.18	1.03
21—22	0.23	0.13	0.33	0 38	0 43	0.48	1.98	0.33
22—23	0.20	0.10	0.30	0.35	0.40	0.45	1.80	0.30
23—24	0.23	0.13	0.33	0.38	0.43	0.48	1.98	0.33
24— 1	0.10	0 05	0.15	0.20	0.25	0.15	0.90	0.15
1— 2	0.08	0.09	0.10	0 09	0.11	0.13	0.60	0.10
2— 3	0.10	0.11	0.13	0.12	0.14	0.18	0.78	0.13
3— 4	0.23	0.13	0.33	0.38	0.43	0.48	1.98	0.33
4— 5	0.20	0.10	0.30	0.35	0.40	0.45	1.80	0.30
5— 6	0.43	0.33	0.53	0.58	0.63	0.68	3.18	0.53

TABLE E-6. ORIGIN AND DESTINATION SURVEY-PERCENTAGE OF BYPASSABLE TRAFFIC

Total number of vehicles per day		Through fast moving vehicles	Destinating fast moving vehicles	Percentage of bypassable traffic to total traffic per day	
Fast moving vehicles	All vehicles			Excluding slow moving vehicles	All vehicles
1	2	3	4	5	6
18360	21600	8640	9720	47.0	40.0

Note : (refer to Table E-1.)

(a) All vehicles (Total number of vehicles originating at cordon points A and B) $\Sigma_D^A (12000) + \Sigma_D^B (9600) = 21600$ (from Table E-1)

(b) Fast moving vehicles (total number of vehicles originating at cordon points A and B—slow moving vehicles) 21600 − 3240 = 18360

(c) Through fast moving vehicles AB (4800) + BA (3840) = 8640

(d) Destinating fast moving vehicles 18360 − 8640 = 9720

(e) Percentage of bypassable traffic to total traffic per day

(i) excluding slow vehicles = 8640/18360 × 100 = 47.0

(ii) all vehicles = 8640/21600 × 100 = 40.0

TABLE E-7 : ORIGIN AND DESTINATION SURVEY-SUMMARY OF ANALYSIS OF DELAYS ON THE ENTIRE ROUTE

Name of Town : Date :

Sl. No.	Route section	Length (km)	Period of journey (hours)	Average delay of six runs (minutes)
1.	2	3	4	5
1.	A—1	2.0	8.00—12.00	2.38
			12.00—16.00	0.66
			16.00 - 20.00	1.87
			20.00—08.00	0.61
2.	1—2	1.0	8.00—12.00	1.15
			12.00—16.00	0.32
			16.00—20.00	0.91
			20.00—08.00	0.29
3.	2—3	1.20	8.00—12.00	2.94
			12.00—16.00	0.51
			16.00—20.00	2.50
			20.00—08.00	0.60
4.	3—4	1.30	8.00—12.00	2.78
			12.00—16.00	0.54
			16.00—20.00	2.26
			20.00—08.00	0.57
5.	4—5	1.50	8.00—12.00	1.37
			12.00—16.00	0.43
			16.00—20.00	1.07
			20.00—08.00	0.37
6.	5—B	1.00	8.00—12.00	1.00
			12.00—16.00	0.28
			16.00—20.00	0.84
			20.00—08.00	0.24

Note : Average delays for the chosen journey periods have been computed from Col. 9 of Table E-5.

TABLE E-8. ANALYSIS OF OBSERVED AND ESTIMATED TRAVEL SPEEDS AND DELAYS

1. *Travel time and delay characteristics of local traffic*

Sl. No.	Route Section	Length (km)	Average hourly local traffic volume (veh/hr)	Average travel time observed (minutes)	Average travel speed (km/h) $\frac{\text{Col. 3}}{\text{Col. 5}} \times 60$	Average free speed observed (km/h)	Average travel time with free speed (minutes) $\frac{\text{Col. 3}}{\text{Col. 7}} \times 60$	Average delay (minutes) Col. 5-Col. 8
1	2	3	4	5	6	7	8	9
				A. *With bypassable traffic (Observed)*				
1.	A—1	2.0	340	3.78	31.80	50.0	2.40	1.38
2.	1—2	1.0	364	1.87	31.75	50.0	1.20	0.67
3.	2—3	1.2	640	3.08	23.38	50.0	1.44	1.64
4.	3—4	1.3	590	3.10	25.16	50.0	1.56	1.54
5.	4—5	1.5	240	2.61	34.48	50.0	1.80	0.81
6.	5—B	1.0	290	1.79	33.52	50.0	1.20	0.59
				B. *Without bypassable traffic (Estimated)*				
1.	A—1	2.0	340	2.77	43.29	50.0	2.40	0.37
2.	1—2	1.0	364	1.39	42.90	50.0	1.20	0.19
3.	2—3	1.2	640	1.87	38.50	50.0	1.44	0.43
4.	3—4	1.3	590	1.98	39.30	50.0	1.56	0.42
5.	4—5	1.5	240	2.0	44.80	50.0	1.80	0.20
6.	5—B	1.0	290	1.36	44.00	50.0	1.20	0.16

TABLE E-8 *Contd.*

2. *Travel time and delay characteristics of bypassable (Through) Traffic*

Route section	Length (in km)	Average volume (in veh/hr.)	Average travel time (in minutes)	Average travel speed (in kph)	Average free speed (in kph)	Average travel time with free speed (in minutes)	Average delay (in minutes)
			A—*With local traffic (Observed)*				
A—B	8.0	360	16.23	29.60	50.0	9.60	6.63
			B—*Without local traffic (Estimated)*				
A—B	8.0	360	11.16	43.0	50.0	9.60	1.56

Notes : 1. Average hourly local traffic in vehicles per hour is obtained by deducting average hourly through traffic (from Table E-1) from average hourly total traffic on the six sections (given in Table E-3). For example, for Section A-I, it is 700-360 = 340

2. + From speed volume relationship (see para 5.5.1. of text)

$$Vest = Vf - 0.016Q$$

Where Vest = estimated speed in kmph

Vf = average free speed in km/h— 48.73

Q = average hourly traffic volume in vehicles per hour

TABLE E-9 : ORIGIN AND DESTINATION SURVEY-ROUTE WISE ANALYSIS OF THROUGH TRAFFIC

Date :

Name of Town : Route Course :

Period (hours)	Trucks, Truck-trailers	Buses	Cars/Jeeps, Vans, Three-wheelers	Scooters/Motor Cycles	Total
8.00—12.00	1575	16	441	690	2712
12.00—16.00	565	6	158	247	976
16.00—20.00	1425	15	399	623	2462
20.00—08.00	1435	14	402	629	2480
Total	5000	51	1400	2189	8640

Note : The sample size as interviewed adopting Form 2 has been expanded to the population with respect to traffic counts made in Form 1, and the expanded figures are shown in this Form.

TABLE E -11. ASSESSMENT OF DIRECT ECONOMIC LOSSES FOR LOCAL AND THROUGH TRAFFIC (BASE YEAR)

Nome of Town : Date :

		Man hours lost per day +	Man hours lost per year (Col. 3 × 365)	Total cost of manhours lost per year in rupees (Col 4 × cost/hr)	Total extra fuel consumed on entire stretch #	Cost of fuel per litre in rupees	Total cost of extra fuel consumed per year in Rs (Col. 6 × Col. 7)	Total economic losses per year in Rs (Col. 5 + Col. 8)
1	2	3	4	5	6	7	8	9
Local traffic	Car	1016.23	370923.95	5934782.40	872.35	8.0	6978.80	5841761.20
	Scooter/M. Cycle	420.66	153540.90	2456654.40	945.35	8.0	7562.80	2464217.20
	Bus	270.00	98550.00	886950.00	29.20	4 0	116.80	887066.80
	Truck	215.07	78500.55	298302.09	540.20	4.0	2160.80	300462.89
	Cycles/Cycle Rickshaw	479.64	175068.60	437671.50	—	—	—	437671.50
	Animal Drawn Vehicles	1543.53	563388.45	1408471.10	—	—	—	1408471.10
			Total					11439650.69
								or Rs 114.4 lakhs . . . (I)

Through Traffic	Car	473.20	172718.00	2763488.00	226.30	8.0	1810.40	2765298.40
	Scooter/M. Cycle	277.45	101269.00	1620304.00	255.50	8.0	2044.00	1622348.00
	Bus	215.52	78665.00	707985.00	7.30	4.0	29.20	708014.20
	Truck	845.10	308462.00	1172155.60	609.60	4.0	2438.40	1174594.00
				Total				6270254.60
								or Rs 62.71 lakhs . . . (II)
				Grand Total				(I + II) . . . Rs 177.11 lakhs

Notes : 1. + Refer to Col. 11 of Table E-10. For example, for car it is 40.4 + 51.23 + 451.80 + 380.80 + 74.80 + 17.2 = 1016.23

2. # Refer to Col. 22 of Table E-10

3. Man hour cost/passenger of :

Car/Scooter = Rs 16, Bus = Rs. 9, Truck = Rs 3.8

Cycles/Animal Drawn Vehicles = Rs 2.5 (See IRC : SP : 30)

TABLE E-12. PROJECTED ECONOMIC LOSSES FOR THROUGH AND LOCAL TRAFFIC

Name of Town : Base Year

Future date for which projection is made :

Year	Through traffiic (Vehicles/ day)	Direct economic losses for through traffic (lakh rupees)	Local traffic (Vehicles/ day)	Direct economic losses for local traffic (lakh rupees)	Total direct economic losses for local and through traffic (lakh rupees)
0	8640	62.71	59136	114.40	177.11
1	9288	67.41	60910	117.83	185.24
2	9936	72.12	62684	121.26	193.38
3	10714	77.76	64458	124.70	202.46
4	11491	83.40	66232	128.13	211.53
5	12355	89.68	68006	131.56	221.24
6	13306	96.57	70372	136.14	232.71
7	14256	103.47	72146	139.57	243,04
8	15379	111.62	74511	144.14	255.76
9	16502	119.78	76877	148.72	268.50
10	17798	129.18	79242	153.30	282.48
11	19094	138.59	81608	157.87	296.46
12	20563	149.24	83973	162.45	311.69
13	22118	160.54	86339	167.02	327.56
14	23760	172.45	89295	172.74	345.19
15	25488	184.99	91661	177.32	362.31
16	27475	199.42	94618	183.04	382.46
17	29462	213.84	97574	188.76	402.60
18	31709	230.14	100531	194.48	424.62
19	34128	247.70	103488	200.20	447.90
20	36634	265.89	106445	205.92	471.81

Note : Projection formula

$P = A (1 + r)^n$

where P = future traffic

A = present traffic

r = annual growth rate (7.5% for through traffic)
(3.0% for local traffic)

n = number of years

TABLE E—10 ANALYSIS OF ECONOMIC TO LOCAL AND THROUGH TRAFFIC

1. LOSSES IN MAN HOURS AND FUEL TO LOCAL TRAFFIC DUE TO PRESENCE OF BYPASSABLE TRAFFIC

Name of Town

Sl. No	Route section	Length (km)	Vehicle type	Volume per day	Loss in man hours per day: Average delay per vehicle (in mins.) O	Average delay per vehicle (in mins.) E	Average occupancy rate	Man hours lost per day (hours) $\frac{O}{5 \cdot 6 \cdot 8}$	Man hours lost per day (hours) $\frac{E}{5 \cdot 7 \cdot 80}$	Extra man hours (0-E) (9-10)	Extra fuel consumed: Extra fuel consumed in acceleration and declaration process: Mean no. of process	Extra fuel consumed per process · 10^{-2}	Extra fuel consumed per day (in litres) $10^{-2} \cdot 15 \times 12 \cdot 13$	Mean stopped time in mins.	Extra fuel consumed in idling: Extra fuel consumed per minutes of idling · 10^{-2}	Extra fuel consumed per day in litres · $10^{-4} \cdot 5 \cdot 15 \times 16$	Extra wear and tear in terms of extra fuel consumed: Present rate of consumption	Extra wear-tear in term of fuel consumed in litres per day $18 \times (14 + 17)$	Total extra fuel consumed per day: O (14 + 17 + 19)	E	Extra Fuel (0 – E) (20-21)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	A-1	2.0	Car	600	1.38	0.37	4.0	55.20	14.80	40.4	2	2268	0.27	0.6	31706	1.14	0.4579	0.64	2.05	1.97	0.08
			Scooter/ M. Cycle	1111	1.38	0.37	1.5	38.32	10.30	28.02	2	2268	0.50	0.6	31706	2.11	0.4579	1.19	3.80	3.60	0.20
			Bus	51	1.38	0.37	50	58.70	15.7	43.00	2	6350	0.06	0.6	32976	0.10	0.4579	0.07	0.23	0.22	0.01
			Truck	3881	1.38	0.37	2.0	178.50	47.8	130.70	2	4173	3.23	0.6	32976	7.60	0.4579	4.95	15.78	15.00	0.78
			Cycles/ Cycle-Rickshaw	1508	7.00	4.00	1.5	263.90	150.80	113.10											
			Animal drawn vehicles	1009	16.00	6.00	2.0	538.13	201.80	336.33											
2	1-2	1.0	Car	1600	0.67	0.19	4.0	71.50	20.27	51.23	2	2268	0.72	0.4	31706	2.00	0.4579	1.24	3.96	3.80	0.16
			Scooter M. Cycle	1811	0.67	0.19	1.5	30.33	8.60	21.73	2	2268	0.82	0.4	31706	2.20	0.4579	1.38	4.40	4.20	0.20
			Bus	53	0.67	0.19	50	29.60	8.40	21.20	2	6350	0.06	0.4	32976	0.06	0.4579	0.05	0.17	0.16	0.01
			Truck	2612	0.67	0.19	2.0	58.30	16.50	41.80	2	4713	2.17	0.4	32976	3.40	0.4579	2.55	8.12	7.80	0.32
			Cycle/ Cycle-Rickshaw	1546	3.50	2.00	1.5	135.20	77.30	57.90											
			Animal drawn vehicles	1114	8.00	3.00	2.0	297.00	111.30	185.70											
3	2-3	1.*	Car	5600	1.64	0.43	4.0	612.3	160.5	451.80	3	2268	3.8	0.6	31706	10.6	0.4579	6.59	20.99	20.0	0.99
			Scooter/ M. Cycle	5945	1.64	0.43	1.5	243.7	63.9	179.80	3	2268	4.04	0.6	31706	11.3	0.4579	7.00	22.30	21.4	0.90
			Bus	93	1.64	0.43	50	127.1	33.3	93.80	3	6350	0.17	0.6	32976	0.18	0.4579	0.16	0.51	0.49	0.02
			Truck	50	1.64	0.43	2.0	2.73	0.72	2.01	3	4173	0.09	0.6	32976	0.09	0.4579	0.08	0.26	0.24	0.02
			Cycles/ Cycle Rickshaw	2136	4.20	2.40	1.5	224.30	128.20	96.10											
			Animal drawn vehicles	1536	9.60	3.60	2.0	491.50	184.30	307.20											
4	3-4	1.3	Car	5100	1.54	0.42	4.0	523.60	142.80	380.80	3	2268	3.47	0.6	31706	9.7	0.4579	6.03	19.20	18.40	0.80
			Scooter/ M. Cycle	5460	1.54	0.42	1.5	210.21	57.30	152.91	3	2268	3.71	0.6	31706	10.3	0.4579	6.41	20.40	19.60	0.80
			Bus	85	1.54	0.42	50.0	109.00	29.70	79.30	3	6350	0.16	0.6	32976	0.16	0.4579	0.14	0.46	0.44	0.02
			Truck	25	1.54	0.42	2.0	1.28	0.35	0.93	3	4173	0.04	0.6	32976	0.04	0.4579	0.03	00.11	0.10	0.01
			Cycles/ Cycle Rickshaw	2029	4.50	2.60	1.5	228.30	131.90	96.40											
			Animal drawn vehicles	1461	10.40	3.90	2.0	506.50	189.90	316.60											
5	4-5	1.5	Car	1839	0.81	0.20	4.0	99.30	24.50	74.80	2	2268	0.83	0.4	31706	2.33	0.4579	1.40	4.56	4.30	0.26
			Scooter, M. Cycle	1582	0.81	0.20	1.5	32.00	7.90	24.10	2	2268	0.71	0.4	31706	2.00	0.4579	1.20	3.91	3.70	0.21
			Bus	35	0.81	0.20	50.0	23.60	5.80	17.80	2	6350	0.04	0.4	32976	0.04	0.4579	0.03	0.11	0.10	0.01
			Truck	100	0.81	0.20	2.0	2.70	0.67	2.03	2	4173	0.08	0.4	32976	0.13	0.4579	0.09	00.30	0.20	0.10
			Cycle/ Cycle-Rickshaw	1281	5.00	3.00	1.5	160.10	96.06	64.04											
			Animal drawn vehicles	923	12.00	4.50	2.0	369.20	138.40	230.80											
6	5-B	1.00	Car	600	0.59	0.16	4.0	23.6	6.4	17.2	2	2268	0.27	0.4	31706	0.76	0.4579	0.47	1.50	1.40	0.10
			Scooter/ M. Cycle	1311	0.59	0.16	1.5	19.3	5.2	14.1	2	2268	0.59	0.4	31706	1.66	0.4579	1.03	3.28	3.10	0.18
			Bus	42	0.59	0.16	50.0	20.7	5.6	15.1	2	6350	0.05	0.4	32976	0.05	0.4579	0.04	0.14	0.13	0.01
			Truck	2618	0.59	0.16	2.0	51.5	13.9	37.6	2	4177	2.18	0.4	32976	3.45	0.4579	2.50	6.35	6.10	0.25
			Cycle/ Cycle-Rickshaw	1388	3.50	2.00	1.5	121.50	69.4	52.1											
			Animal drawn vehicles	1001	8.00	3.00 *	2.0	266.90	100.0	166.9											

2. LOSSES IN MAN HOURS AND FUEL TO BYPASSABLE TRAFFIC DUE TO PRESENCE OF LOCAL TRAFFIC

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	A-B	8.0	Car	1400	6.63	1.56	4.0	618.8	145.6	473.20	2	2268	0.64	1.5	31706	6.65	0.4579	3.33	10.62	10.00	0.62
			Scooter/ M. Cycle	2189	6.63	1.56	1.5	362.8	85.35	277.45	2	2268	0.99	1.5	31706	10.40	0.4579	5.21	16.60	15.90	0.70
			Bus	51	6.63	1.56	50.0	281.80	66.28	215.52	2	6350	0.06	1.5	32976	0.25	0.4579	0.14	0.45	0.43	0.02
			Truck	5000	6.63	1.56	2.0	1105.00	259.90	845.10	2	4173	4.17	1.5	32976	24.70	0.4579	13.20	42.07	40.4	1.67

Note : O—Observed value for bypassable traffic moving along with local traffic

E—Estimated value for bypassable traffic separated from local traffic